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(2) Magnetic Stirrer for Use in the Cup Type of Moisture-Transfusion Apparatus

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INTERNAL STIRRING OF LIQUIDS

(1) Magnetic Stirrer for an Evacuated Sorption Apparatus[1]

By

Samuel A. Woodruff, Student Assistant
and
Alfred J. Stamm, Principal Chemist

In order to ensure that the vapor over a liquid is truly in equilibrium with the liquid, it is important to break the surface of the liquid continually, even in an evacuated system. Violent stirring is not desired because any liquid spray may cause a supersaturated condition.

The simple device shown in Figure 1 met these requirements admirably.

The glass bulb, B, containing the liquid to be stirred, has a heavy platinum wire support, P, sealed as shown into the wide neck of the bulb. This serves as the support for the stirring paddle, S, which is made from a glass rod flattened at the end. The upper part of the stirrer consists of a glass tube into which an iron nail, N, is sealed. The upper and lower parts of the stirrer are connected through a heavy platinum wire which is looped around the platinum support, P. The stirrer thus oscillates freely about P as an axis. M is a small electromagnet coil taken from an old electric doorbell. This is connected to the secondary coil of a doorbell transformer (18 volts). The 110-volt primary coil of the transformer is connected in series with a 20- to 40-watt lamp, in the socket of which is placed a 60-watt 120-volt "flasher button", a device for thermally making and breaking the circuit once or twice a second. The intermittent current through the primary of the transformer causes a similar intermittent current to flow through the secondary of the transformer and through the electromagnet. N is thus pulled over to M and released once or twice a second, causing S to oscillate slowly within the liquid.

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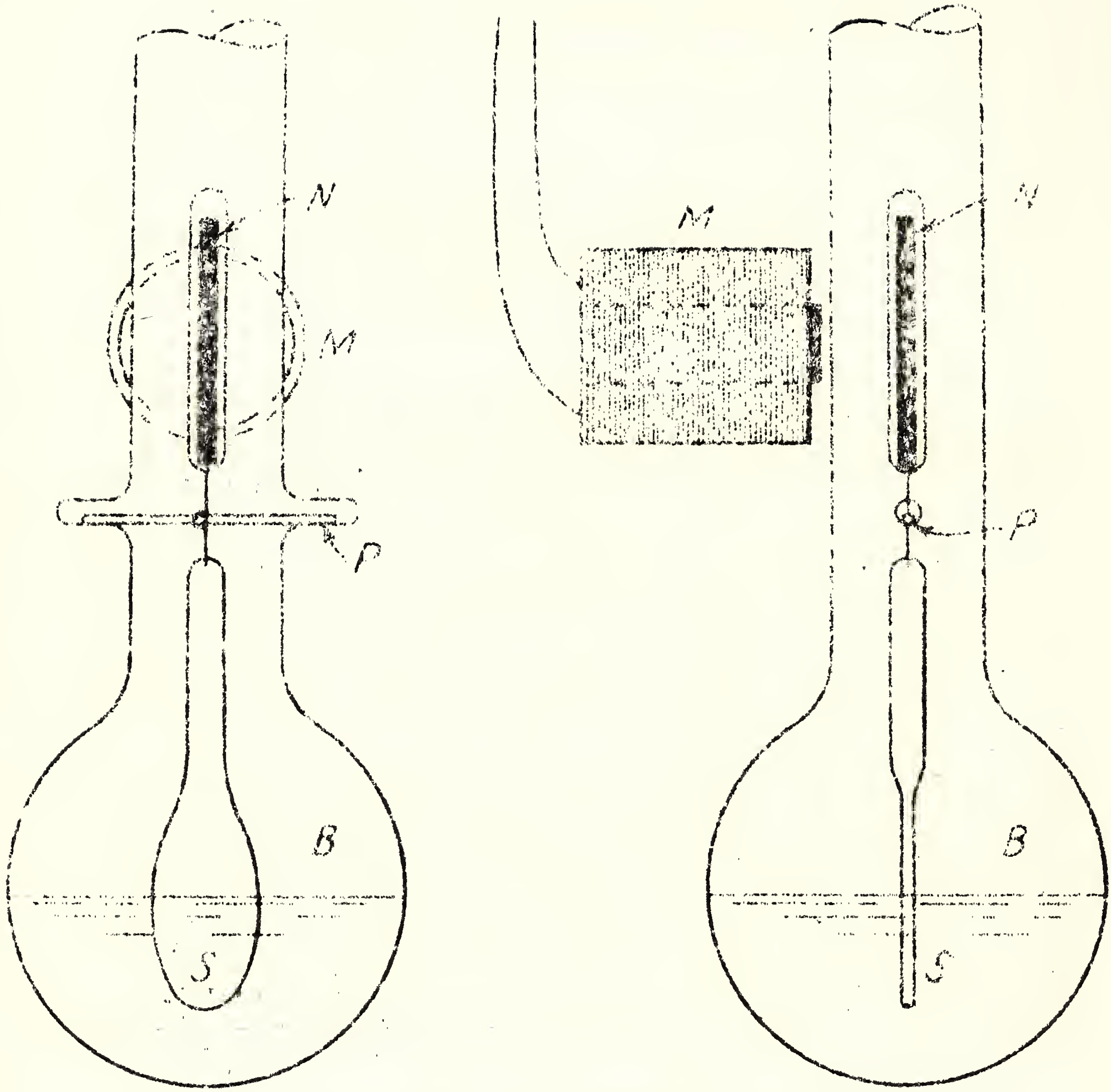

Figure 1.--Internal stirrer for an evacuated

sorption apparatus.

(2) Magnetic Stirrer for Use in the Cup Type of Moisture-Transfusion Apparatus[2]

By

Horace K. Burr, Student Assistant
and
Alfred J. Stamm, Principal Chemist

The cup type of moisture-transfusion apparatus is the chief means used for determining the passage of moisture under a relative humidity gradient through paper, impregnated paper, film material such as cellophane, and thin sections of wood.

Water, an aqueous solution of sulfuric acid, or a saturated salt solution in equilibrium with a specific relative humidity is poured into the bottom of a cup. The membrane material to be studied is sealed across the top of the cup. The cup is then weighed and the loss or gain in weight with time determined when the cup is exposed to a lower or higher relative humidity than that set up within the cup.

This simple technique is subject to one serious source of error, especially for relatively permeable membranes -- namely, vapor is not supplied to the lower surface of the membrane as rapidly as it can pass through the membrane, and moisture is not removed from the upper surface of the membrane as rapidly as it passes through the membrane. Part of the relative humidity gradient thus occurs through the air on each side of the membrane. This situation can be readily corrected on the outer surface of the membrane, when humidity rooms or chambers are used, by blowing air across the surface with an electric fan, or rapidly passing air over the surface from a humidification train.

The device shown in Figure 1 was designed to correct this same difficulty within the cup. It does not interfere with making a vapor-tight seal of the membrane. It permits easy removal of the cups for weighing and does not increase the weight of the cups sufficiently to decrease the accuracy of weighing. It consists of

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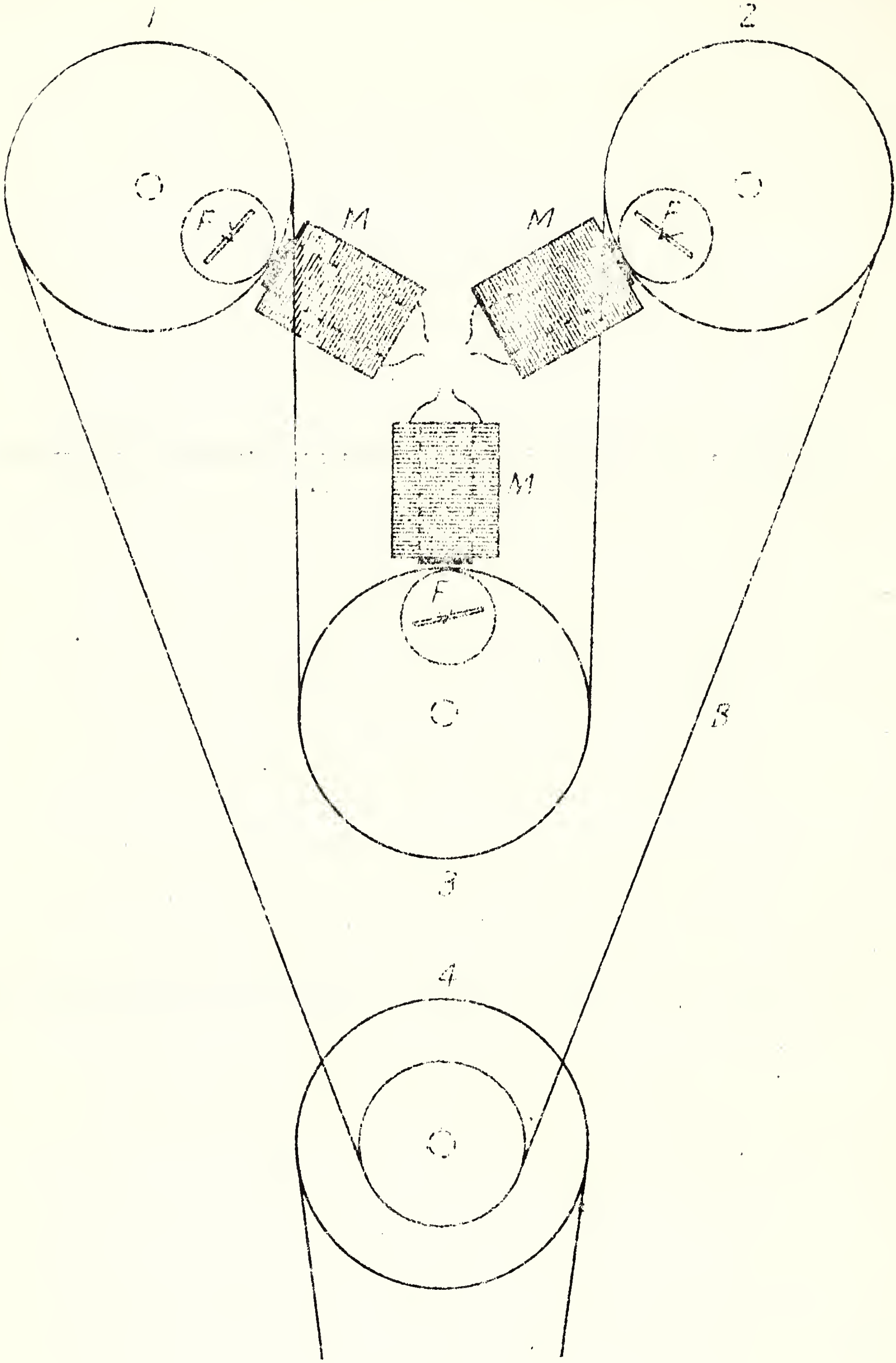

Figure 1.--Internal stirrer for a cup-type moisture transfusion apparatus.

four horizontally mounted pulleys. Pulleys 1, 2, and 3 serve as the supports for three moisture-transfusion cups, in this case glass crystallizing dishes, which are slightly smaller in diameter than the pulleys. The cups may be clipped to the pulleys so as to be readily removable. The three pulleys are rotated by a continuous belt, B, by pulley 4.

Rings made by bending 18-gage sheet-iron strips 1 cm. wide into circular cylinders 3 cm. in diameter were completely covered with tinfoil on the circular surfaces as well as on the ends to make sealed drums, F. Small tinfoil vanes, V, were sealed horizontally on the top face of the drums. These drums, which served as the stirrers, weighed only 5 grams each. They were floated on the liquid in the crystallizing dishes, after which the membranes were sealed to the top. Three electromagnet coils, M, taken from old electric doorbells, were mounted so that the magnet surface just cleared the side of the crystallizing dish. These electromagnets were operated from the secondary of an ordinary doorbell transformer (18 volts). When the pulleys were operated at a speed of about 60 revolutions per minute, the drums, F, were held in a position near the electromagnets as the pulleys and crystallizing dishes rotated. Because of the friction of the drum stirrers on the side of the crystallizing dishes, they rotate about their own axes. The vane, V, on the drum thus rotates with respect to the base on which the apparatus is mounted and also with respect to the crystallizing dish, causing an efficient stirring of the air. The rotation of the crystallizing dish with respect to the stirring drum, F, also adequately caused a continual formation of a new liquid surface.

The apparatus was set up in various relative humidity rooms for making the measurements. An electric fan was directed across the membrane faces. Good check values were obtained when similar membranes were used on each of the crystallizing dishes with a liquid giving the same relative humidity inside each. When the stirring drum was left out of one of the crystallizing dishes, the rate of loss of moisture from that dish was materially less than from the other dishes. When four thicknesses of noncoated Cellophane No. 600 were used for the membrane and the relative humidity gradient was from 100 to 80 percent, the presence of the stirrer increased the rate of moisture loss by about 70 percent. Further increase of the rate of stirring had a negligible effect upon the rate of loss of moisture.